JOINT PRECISION APPROACH AND LANDING SYSTEM (JPALS) – COMMON AVIONICS AND AIRCRAFT ARCHITECTURE

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Outline

- Concepts
  - Augmented GPS
  - LDGPS versus SRGPS
- Operational Environments
- How SRGPS Works
- Concept of Operations
- Equipment
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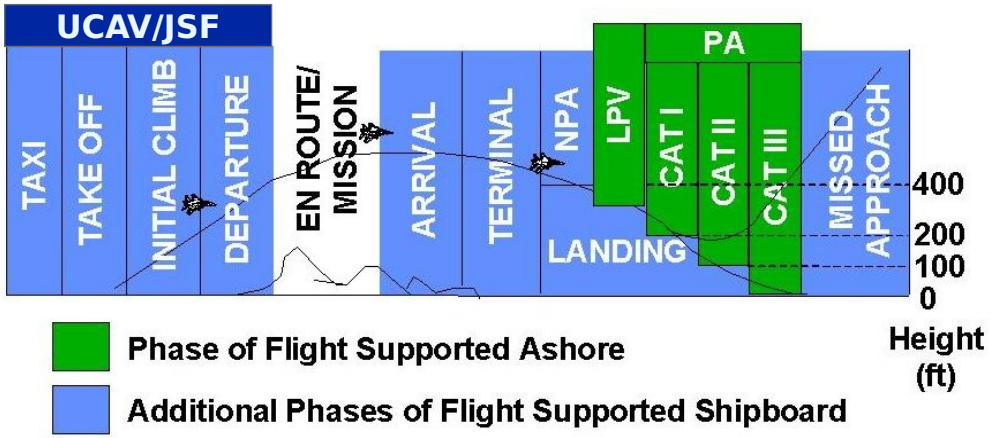
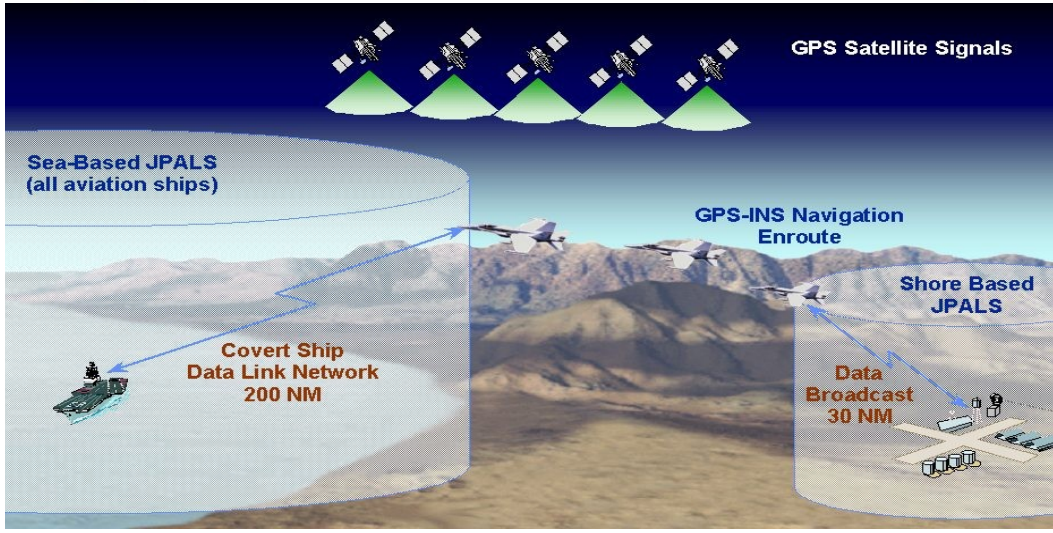
JPALS Concept Basics

- **JPALS is GPS-INS based but requires an accuracy level not provided by “unaided” GPS.**
- **Both shore and sea based systems use differential GPS-INS to get the accuracy required.**
- **Shore based system uses a Local Area Differential GPS (LDGPS) solution. Landing field calculates a local area GPS correction and broadcasts to aircraft in area – one-way datalink.**
- **Sea based system uses a relative solution (Shipboard Relative GPS (SRGPS)). Ship and aircraft, through two-way datalink, calculate very accurate relative solution as means to remove common GPS errors.**

SRGPS Concept

- JPALS provides a GPS/INS based PALS capability ashore and afloat
- One interoperable system
  - Between DoD and Allies,
  - Meets FAA requirements
  - ICAO compliant
- Enabling technologies
  - Differential Global Positioning System (GPS) with advanced anti-jam
  - Inertial Navigation System (INS)
  - Low Probability of Intercept (LPI) data link network



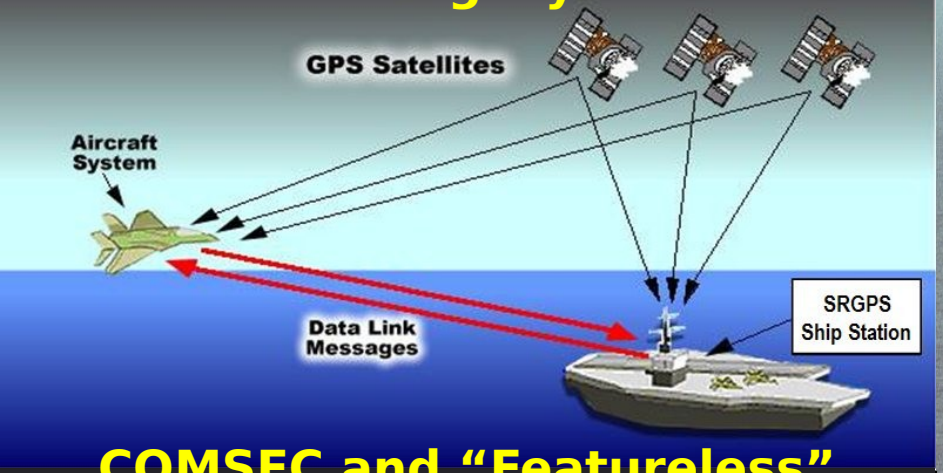


JPALS
Operational Environments

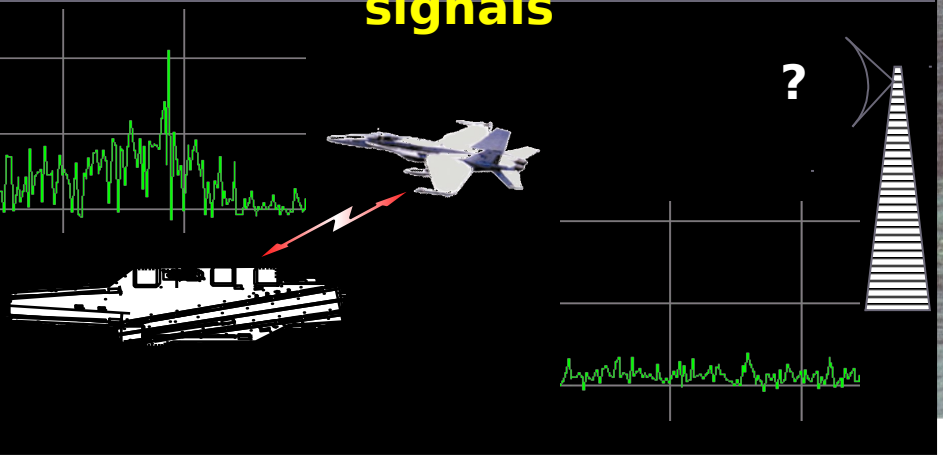
Navy responsible for shipboard environment

How SRGPS Works

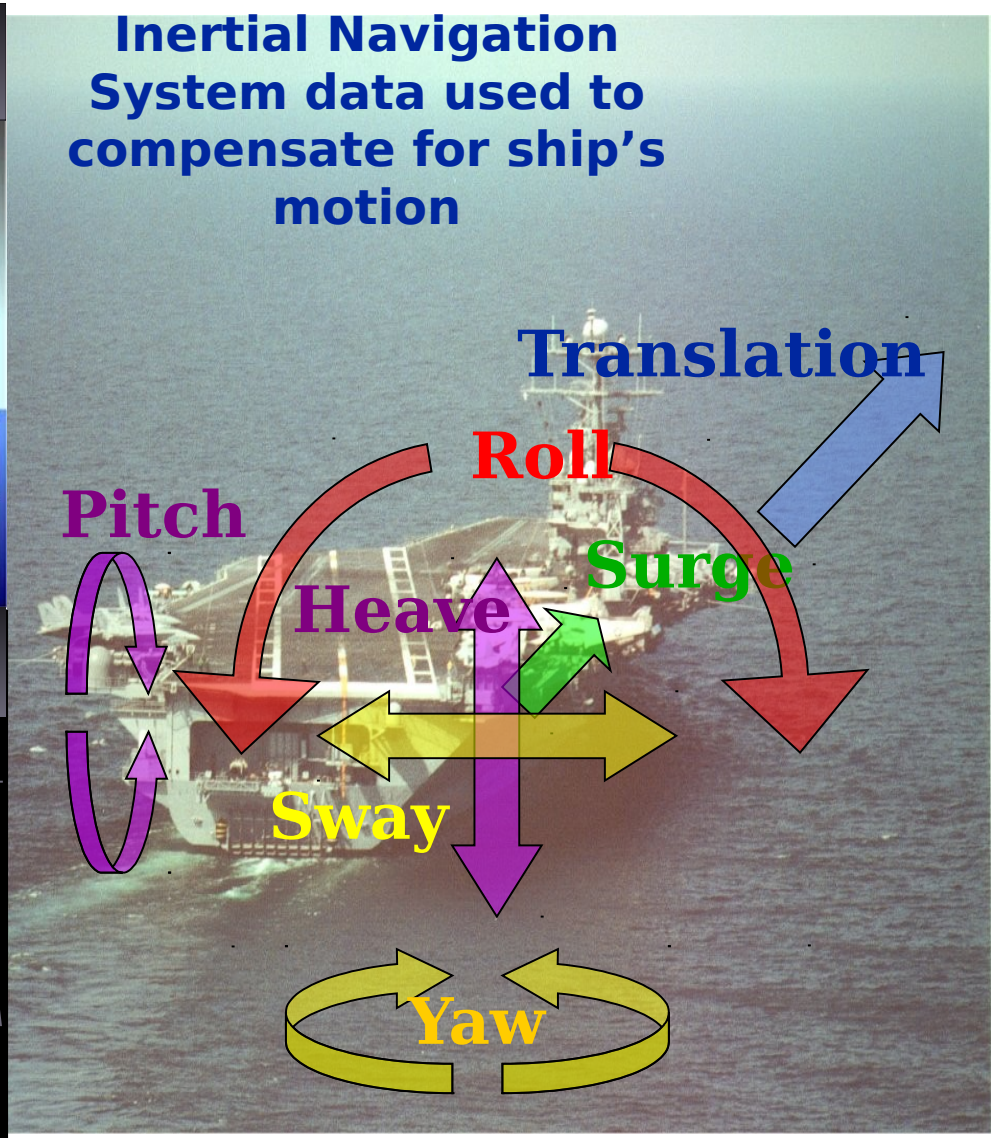
Differential GPS gives relative position with high accuracy and integrity



COMSEC and "Featureless" Spread Spectrum protect the signals



Inertial Navigation System data used to compensate for ship's motion



Integrated Concept of Operations

(EMCON Compatible with SRGPS)

50 nm **CCA coverage**

Two-way data comm with ship within 50 nm to support NATOPS requirements under all conditions including EMCON. Position reports supplement radar and IFF data in CCA displays

200 nm **Ship Location coverage**

Ship to Air broadcast allows aircraft to find ship under all conditions including EMCON, out to 200 nm

Standard NATOPS arrivals or direct 4-D routing (best time/fuel mgt.)

10 nm **Approach coverage**

Supports precision nav (15 cm) within 10 nm, 360 deg around the ship. Downlink to ship provides for CATCC, LSO and Primary to monitor approach

20 nm **A/C Situational Awareness**

State reports provide data that CNS-ATM integrations can use for Collision avoidance and Cockpit Display of Traffic Information (CDTI) under EMCON.
Active at 50 nm (T) 200 nm (O)

Marshal

Guidance off the cat & departure

CASE II/III, CASE I, bolter and waveoff patterns supported

Ashore **30 nm**

ICAO/ NATO compatible approach capability within 30 nm of airfield

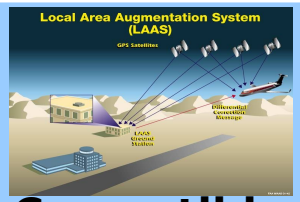
Collocated Nets

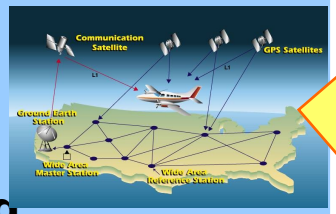
Multiple Control Platforms in Same Net

SRGPS JPALS Equipment

Ground / Ship

Fixed/Civil/ International

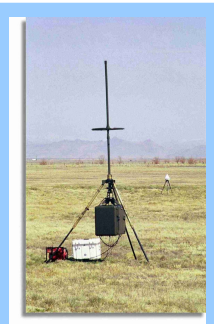




Compatible with Joint and Civil Systems

Tactical/ Special Mission

Secure, Anti-Spoof Tactical Systems, Rapid Set-Up and Deployment



Shipboard

COMSEC and TRANSEC ship data network; Communications and Navigation, Automatic

Airborne

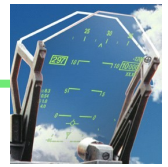
VHF

VHF

UHF

Data Link

GPS & INS



Mission Computer

Displa

Electronics

Antenn

No additional aircraft weight or cube for JPALS

JPALS Testing Successes

- **Automatic shipboard landing**
  - **Apr 01 - Conducted shipboard test of SRGPS aboard USS Theodore Roosevelt (CVN-71), accomplishing 10 fully auto-coupled landings**

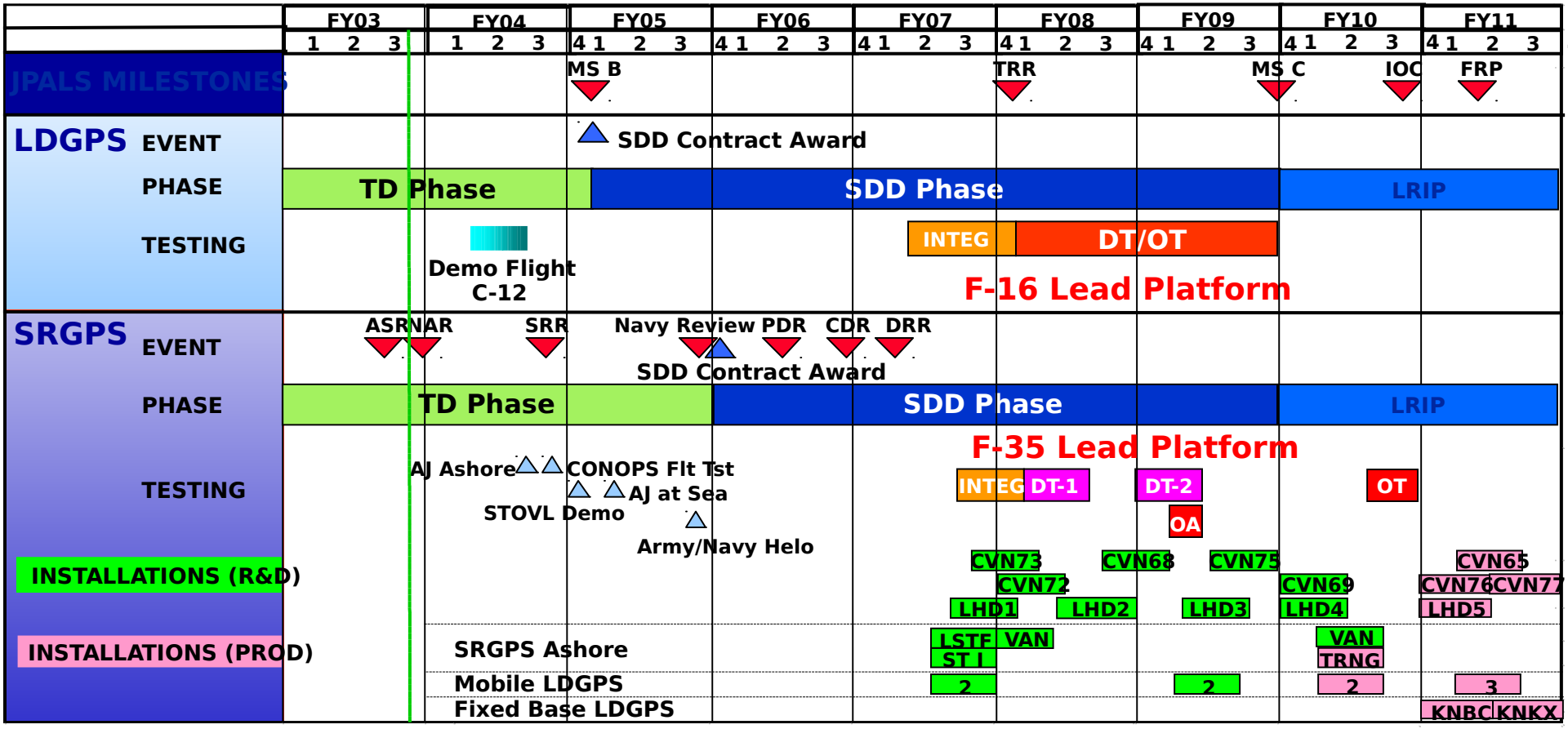
- **Jamming environment**
  - **Jul - Aug 01 - Completed 276 approaches, 154 in clear air 122 while being jammed approaches at Holloman AFB, NM**

- **Civil interoperability**
  - **Aug 01 - Flew LAAS avionics (FedEx 727) against the JPALS ground station to perform 10 auto-coupled landings.**

- **Pegasus automatic shore-based landing**
  - **Feb 03 - Pegasus X-47A Naval UCAV demonstrator first flight. Demonstrated 4 inch SRGPS accuracy throughout flight**

Significant Risk reduction since 2001

JPALS Schedule



TD: Technology Development
SDD: System Development & Demonstration
LRIP: Low Rate Initial Production
DT/OT: Developmental Test/Operational Test

Navy SRGPS JPALS Program Tiers

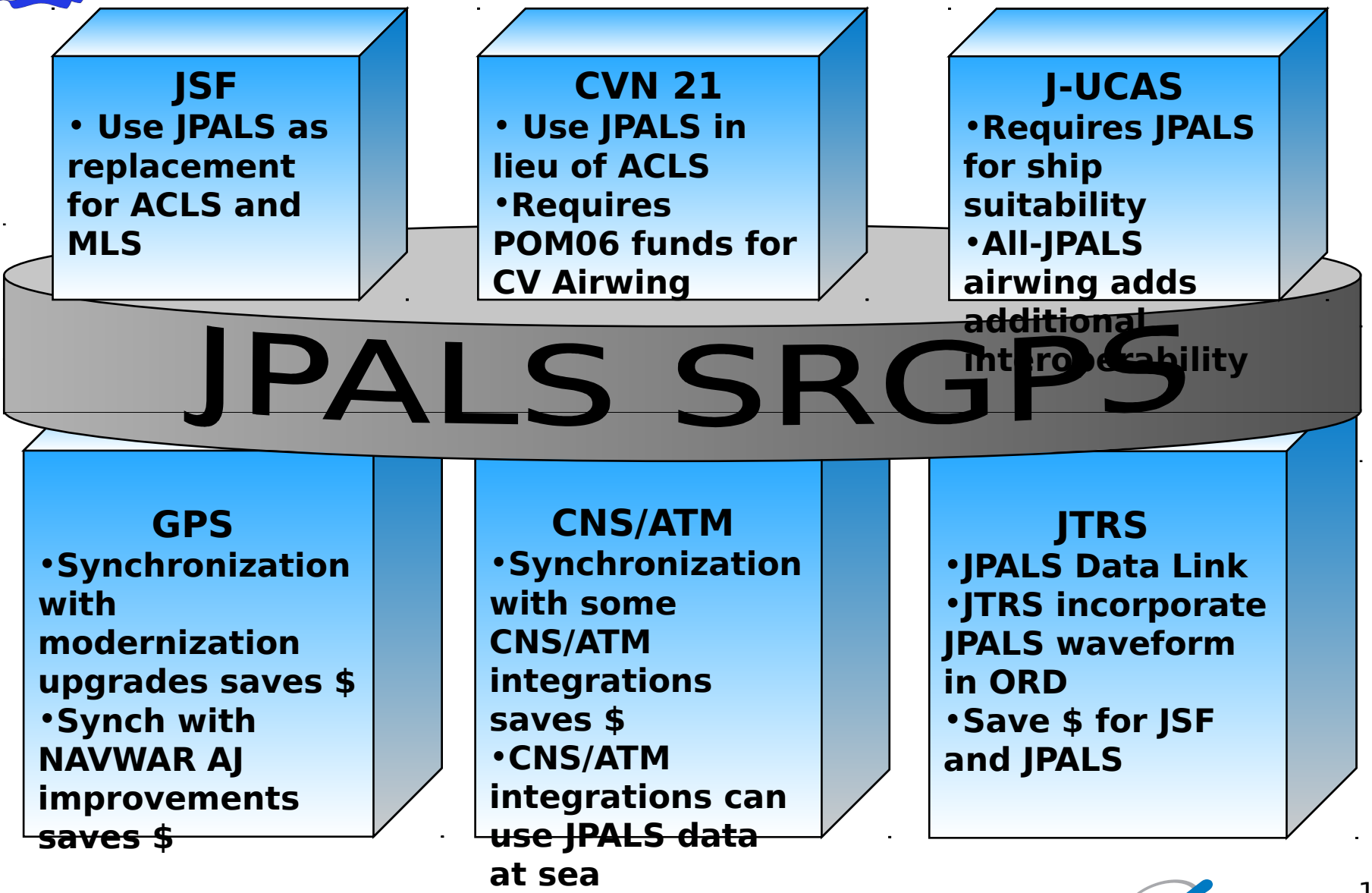
- Tier 1 – JSF, J-UCAS, CV/CVN and L-Class ships
- Tier 2 – Remainder of CV Airwing
  - Depends on Tier 1
  - Allows retirement of SPN-46 and SPN-42T (unless selected as backup)
- Tier 3 – Small combatants and associated USCG helos
  - Depends on Tiers 1 & 2
- Tier 4 – Remainder of MEU composite squadron
  - Depends on Tier 2
  - Allows retirement of SPN-35
- Tier 5 – Maritime patrol aircraft and TACAN ships
  - Depends on Tier 3
  - Allows retirement of URN-25 at sea
- Tier 6 – Remainder of shore-based aircraft
  - Depends on USAF LDGPS program
  - Allows retirement of FPN-63 if Tiers 4 and 5 are also completed
- Tier 7 – PALS Backup
  - Independent of other Tiers

A building-block approach to provide flexibility in requirements and phased affordability

SRGPS Tiers Schedule

	Fleet Ships & Aircraft	R&D Starts	Prod Starts	Installations Begin	Installations Finish
First Tier	J SF, J -UCAS, CV, LH	FY98	FY09	FY10	FY13
Second Tier	CV Airwing	FY06	FY10	FY11	FY18
Third Tier	Small Ships	FY09	FY11	FY12	FY21
Fourth Tier	LH Airwing	FY11	FY13	FY14	FY22
Fifth Tier	TACAN Ships, Maritime Air	FY12	FY14	FY15	FY22
Sixth Tier	Land Based Air	FY13	FY15	FY16	FY22
Seventh Tier	Backup System	FY13	FY16	FY17	FY20

SRGPS JPALS Co-Dependencies


JSF
• Use JPALS as replacement for ACLS and MLS
CVN 21
• Use JPALS in lieu of ACLS
•Requires POM06 funds for CV Airwing
J-UCAS
•Requires JPALS for ship suitability
•All-JPALS airwing adds additional interoperability
JPALS SRGPS
GPS
•Synchronization with modernization upgrades saves $
•Synch with NAVWAR AJ improvements saves $
CNS/ATM
•Synchronization with some CNS/ATM integrations saves $
•CNS/ATM integrations can use JPALS data at sea
JTRS
•JPALS Data Link
•JTRS incorporate JPALS waveform in ORD
•Save $ for JSF and JPALS

Summary

- **The choice of GPS-INS as the underlying technology for JPALS/SRGPS has been validated by its utility in enabling other new programs such as JSF, J-UCAS, and CVN 21 to meet their requirements.**
- **JPALS will transform precision landing at sea and provide a universally available and interoperable system for use ashore.**
- **Preliminary successes have mitigated major program risks.**

Navy JPALS POC's

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